

Magnesium Sulfate and Dexmedetomidine with 0.5% Ropivacaine in Infraclavicular Brachial Plexus Block: A comparative Study.

Ratnam Raoji¹

¹Associate Professor, Department of Anesthesiology, Prathima Institute of Medical Sciences, Karimnagar, Telangana,

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ABSTRACT

Background: Brachial plexus block has evolved as an important tool in the anesthesiologist's armamentarium as a safe alternative to general anesthesia for upper limb surgery and for relief of perioperative pain. **Aims and Objectives:** To evaluate and compare the effect of magnesium sulphate and dexmedetomidine when added to ropivacaine 0.5% for infraclavicular BPB on the duration of analgesia. **Methods:** We carried a randomized double blind controlled study on 150 patients of ASA PS I/II belonging to either sex, aged 20-45 years weighing between 45-75 kgs scheduled for elective upper limb surgeries of mid arm and fore arm. Patients were randomized into three groups Group I (Ropivacaine group), Group II (Magnesium sulfate group) and Group III (Dexmedetomidine group). The parameters assessed were sensory block and motor block. **Results:** There was no statistical difference between the group's gender, age, weight, ASA physical status classification, or duration of the surgery. Dexmedetomidine group provided the longest duration of analgesia as compared to ropivacaine group ($P = 0.000$) and magnesium sulfate group ($P = 0.000$). **Conclusion:** Magnesium sulfate or dexmedetomidine is a useful adjuvant to ropivacaine for infraclavicular BPB in lengthening the duration of analgesia.

Keywords: Anaesthesia, Dexmedetomidine, Infraclavicular Brachial Plexus Block, Magnesium Sulfate, Ropivacaine.

INTRODUCTION

Brachial plexus block (BPB) is a well-accepted technique to provide anesthesia and analgesia for upper limb orthopedic surgeries. The infraclavicular BPB with coracoids approach has gained popularity because of its consistent bony landmarks, less chances of vascular puncture, pneumothorax and adequate neural blockade.^[1]

Anesthesiologists have performed researches to increase the length of the block with different local anesthetics as increasing the duration of analgesia makes the patient comfortable after surgery. The possibility of opioid receptor has led to the use of various drugs in local blocks to increase the duration of analgesia without increasing side effects. Several studies have used diverse local anesthetics along with narcotics that have completely different outcomes. Magnesium improves the quality of anesthesia both intravenously and intraperitoneally. Various studies have revealed that magnesium is effective in reducing the onset time of the block and

increasing the quality and duration of anesthesia. Dexmedetomidine, a selective α_2 -adrenergic receptor agonist, is considered as an anxiety reducing, sedative, analgesic, and antihypertension drug. Hence, including dexmedetomidine to local anesthetic drugs during the peripheral nervous block can be effective.^[2-4]

The aim of our study was to evaluate and compare the effect of magnesium sulphate and dexmedetomidine when added to ropivacaine 0.5% for infraclavicular BPB on the duration of analgesia, as a primary goal, and the onset times and durations of sensory block (SB) and motor block (MB) and patient's satisfaction, as the secondary goals.

MATERIALS AND METHODS

After obtaining institutional ethics committee approval, we carried a randomized double blind controlled study on 150 patients of ASA PS I/II belonging to either sex, aged 20-45 years weighing between 45-75 kgs scheduled for elective upper limb surgeries of mid arm and fore arm after obtaining written informed consent from all the subjects. The study was done in the department of anaesthesia at Prathima Institute of Medical Sciences, Karimnagar, Telangana state, India, from March 2016 to March 2018.

Name & Address of Corresponding Author

Dr. Ratnam Raoji,
Associate Professor,
Department of Anesthesiology,
Prathima Institute of Medical Sciences,
Karimnagar,
Telangana.

Inclusion Criteria:

Patients undergoing elective upper limb surgeries of mid arm and fore arm

Exclusion Criteria:

1. Patients allergic to the drugs being used,
2. Patients with cardiac disease, hepatic or renal impairment, neuromuscular disorders, uncontrolled hypertension or diabetes mellitus, pregnancy, coagulopathy.

Patients were randomized into three groups based on Mohamed M. Abu Elyazed and Mona M. Mogahed study:^[5]

Group I (Ropivacaine group): Patients received ultrasound-guided infraclavicular brachial plexus block with 35 ml ropivacaine 0.5% and 4 ml normal saline 0.9% (total volume 39 ml)

Group II (Magnesium sulfate group): Patients received ultrasound-guided infraclavicular BPB with 35 ml ropivacaine 0.5% and magnesium sulfate (150 mg) (magnesium sulfate, Sedico) with 2.5 ml normal saline 0.9% (total volume 39 ml)

Group III (Dexmedetomidine group): Patients received ultrasound-guided infraclavicular BPB with 35 ml ropivacaine 0.5% and dexmedetomidine (100 µg) (Precedex, Hospira) with 3 ml normal saline 0.9% (total volume 39 ml).

After preliminary procedural steps like intravenous (i.v.) Lactate Ringer's solution, electrocardiography, pulse oximetry, and noninvasive blood pressure were monitored. O₂ was administered through nasal sponges at a rate of 5 L/min.

Infraclavicular BPB was done while the patient in supine position and once the optimal motor response in the range of 0.3–0.5 mA were obtained; the LA solution was injected around each cord. Injection of LA solution was slowly with frequent aspiration every 3 ml to avoid unintentional intravascular injection. The SB and MB were assessed every 3 min in the first 30 minutes after injection of LA and every 30 minutes postoperatively till the infraclavicular block is worn off.

The SB was assessed using cold test by alcohol swab and by pinprick test. All dermatomes supplied by radial, ulnar, median, and musculocutaneous nerves were assessed. The SB was graded: 0 = normal sensation; 1 = loss of sensation to pinprick; and 2 = loss of touch sensation.

The onset time of the SB is the time interval from injection of LA till the complete SB achieved. The duration of the SB is the time interval between the onset of the complete SB and complete resolution of the SB. Duration of analgesia is the time interval between the onset of the complete SB and the first dose of postoperative analgesia.

The MB was graded according to modified Bromage scale: 0 = no movement in fingers, wrist, and elbow; 1 = finger movement only; 2 = flexion of the wrist against gravity; and 3 = flexion of elbow against gravity.

The onset time of the MB is the time interval between injection of LA and time of the complete MB. The duration of MB is the time interval between the onset of the complete MB and complete resolution of the MB.

The block was considered successful when the SB is 2 and MB is 0 within 30 min after injection of the local analgesia (LA). Otherwise, the block was considered as failed or inadequate block and the patients would receive general anesthesia or analgesia to complete the surgical intervention. These patients were excluded from the study. Intraoperative mean arterial blood pressure (MAP) and heart rate (HR) were recorded preoperatively and every 15 min after the administration of LA solution till the end of surgery. Postoperative pain was assessed using a 10-cm visual analog scale (VAS) (0: no pain to 10: worst pain imaginable) and recorded at admission to postoperative care unit and 1, 2, 4, 6, 8, 12, 18, and 24 h postoperative. Patients received postoperative analgesia in the form of diclofenac sodium (75 mg intramuscular) every 12 h, and if the patient still complained of pain, Fentanyl 1 mg/kg was given i.v. as rescue analgesia. The first dose of diclofenac sodium was given when VAS was >3. Total consumption of rescue analgesia was recorded. Patient's satisfaction was assessed by direct asking the patients regarding the degree of their satisfaction about the block using a four-point scale (1 = very dissatisfied, 2 = dissatisfied, 3 = satisfied, and 4 = very satisfied). Any intraoperative or postoperative complications were recorded.

Statistical analysis

Quantitative data were described as mean ± standard deviation and were analyzed using one-way ANOVA with post hoc Tukey honestly significant difference test. Categorical data were presented as number (n) or percentage (%) and were analyzed by Chi-square test. We used SPSS 20 (SPSS Inc., Chicago, IL, USA) for statistical analysis. P <0.05 was considered statistically significant.

RESULTS

There was no statistical difference between the group's gender, age, weight, ASA physical status classification, or duration of the surgery [Table 1].

The mean duration of analgesia with ropivacaine was 398.40 ± 54.34 minutes, with magnesium sulfate was 601.98 ± 49.65 minutes, and with dexmedetomidine was 689.76 ± 49.86 minutes ($P = 0.000$). Dexmedetomidine group provided the longest duration of analgesia as compared to ropivacaine group ($P = 0.000$) and magnesium sulfate group ($P = 0.000$). The onset of time was quickest in dexmedetomidine group (14.65 ± 2.870 min) and the longest duration of sensory block (631.64 ± 55.48 min) as compared to ropivacaine group ($P = 0.000$) and magnesium sulfate group ($P <$

0.05). Consumption of postoperative rescue analgesia was significantly lower in magnesium

sulfate and dexmedetomidine groups than ropivacaine group ($P = 0.000$: [Table 2]).

Table 1: Characteristics of the sample

S. No	Category	GROUP I (N=50)	GROUP II (N=50)	GROUP III (N=50)	P VALUE
1	Age	38.5±11.5	39.8±11.2	37.6±10.8	0.684
2	Gender (M/F)	32/18	30/20	28/22	0.732
3	Weight	69.56±8.1	68.88±8.7	67.12±9.1	0.327
4	ASA Status (n, %)	Grade 1 40 (80%) Grade 2 10 (20%)	42 (84%) 8 (16%)	38 (76%) 12 (24%)	0.615
5	Duration of Surgery	81.23±11.7	83.89±11.3	79.85±12.3	0.213

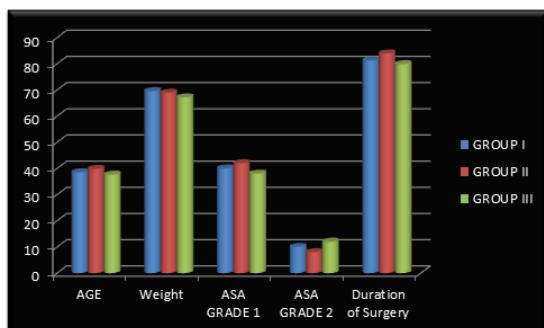


Figure 1: Characteristics of the sample

Table 2: Block Characteristics in all the groups

SNO	Category	Group I (N=50)	Group II (N=50)	Group III (N=50)
1	Mean duration of analgesia	398.40 ± 54.34 minutes	601.98 ± 49.65 minutes	689.76 ± 49.86 minutes
2	Mean onset of time for Sensory block	22.56 ± 2.980 minutes	23.75 ± 5.13 minutes	19.54± 5.43
3	Mean onset of time for Motor block	24.65 ± 2.870 minutes	25.64 ± 5.48 minutes	21.75± 5.97

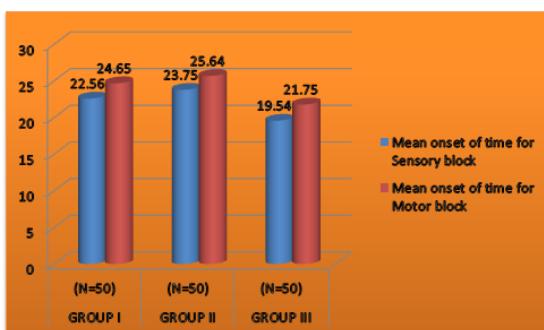


Figure 2: Block Characteristics in all the groups

DISCUSSION

Analgesic effects of magnesium sulfate on the peripheral nerve may be explained by the NMDA receptors antagonist effect that causes prevention of central sensitization from peripheral nociceptive stimulation, as well as magnesium reduced release of acetylcholine through the competitive block of the calcium entry in presynaptic endings. This might also be due to the action of magnesium sulfate on the peripheral nerve is the surface charge theory.^[6,7]

Mukherjee et al studied the effects of using 150 mg magnesium sulfate as an adjuvant to ropivacaine 0.5% for supraclavicular BPB in 100 patients undergoing forearm and hand surgeries. They concluded that the addition of magnesium sulfate to ropivacaine 0.5% resulted in prolongation of the SB and MB durations and the time for the first analgesic request as well as decreased total analgesic consumption without side effects.^[8]

Whereas Haghghi et al in their study on 60 patients undergoing orthopedic surgery of the upper extremities concluded that the addition of 3 mL of 20% magnesium sulfate to lidocaine (5 mg/kg) lengthened the duration of MB and SB of the axillary BPB.^[9]

The favorable effects of magnesium sulfate when added to the LA solution on the improvement of the quality of the regional anesthetic technique, such as i.v. regional anesthesia and intrathecal and epidural block, had been demonstrated in the previous studies.^[10-12]

On the other hand, Choi et al demonstrated that magnesium sulfate (200 mg) added to ropivacaine 0.2% for axillary BPB in 38 patients undergoing upper extremity surgery reduced neither the level of postoperative pain nor the need for the postoperative opioid.^[13]

The results of our research showed that dexmedetomidine provided the quickest onset of action and the longest duration of SB, MB, and analgesia when combined with ropivacaine. However, the incidence of hypotension and bradycardia was higher than other two groups. In agreement with our results, Ammar and Mahmoud concluded that the addition of dexmedetomidine (0.75 µg/kg) to bupivacaine (0.33%) for infraclavicular BPB in 60 patients undergoing upper extremity surgery hastened the onset of SB and MB, prolonged the duration of postoperative analgesia, and decreased opioid requirements with lower pain assessment scale, but there were no side effects documented in their study.^[14]

Esmaoglu et al reported that the addition of dexmedetomidine (100 µg) to levobupivacaine 0.5% for axillary BPB in 60 patients undergoing hand and forearm surgery resulted in fast onset time with long duration of the axillary block with prolonged duration of analgesia. Bradycardia was reported as a side effect in their study.^[15]

However Das et al concluded that the use of dexmedetomidine (100 µg) as an adjuvant to ropivacaine 0.5% for supraclavicular BPB prolonged the SB and MB duration and the duration of postoperative analgesia and decreased total analgesic need with no adverse effects.^[7]

Our study showed that dexmedetomidine induced bradycardia and hypotension in some patients during the procedures, which was evident in other studies as well.^[16,17]

Limitations:

1. Limited number of patients
2. We did not assess the level of sedation. We only reported the incidence of somnolence.

CONCLUSION

Magnesium sulfate or dexmedetomidine is a useful adjuvant to ropivacaine for infraclavicular BPB in lengthening the duration of analgesia. Dexmedetomidine provided quicker onset time and longer durations of SB and MB and longer duration of analgesia with lesser consumption of postoperative rescue analgesia, but the incidence of intraoperative hypotension and bradycardia was higher than magnesium sulfate.

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